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Name of Principal Author and all other author(s):   LTC Ilean Keltz & Dr. Len Adelman

Principal Author's Organization and address:

Phone:_703-697-7434_

Fax:__703-614-4706__
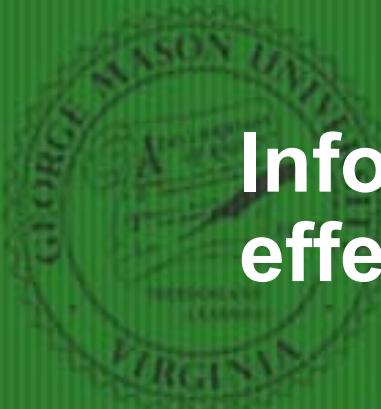
Email:_ilean.keltz@js.pentagon.mil__

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Information order effects: Examining the effect of sequencing and complexity in a long information series

LTC Ilean Keltz, Ph.D.
Phone: 703-697-7434
Email: ilean.keltz@js.pentagon.mil

Dr. Len Adelman
Phone: 703-993-1624
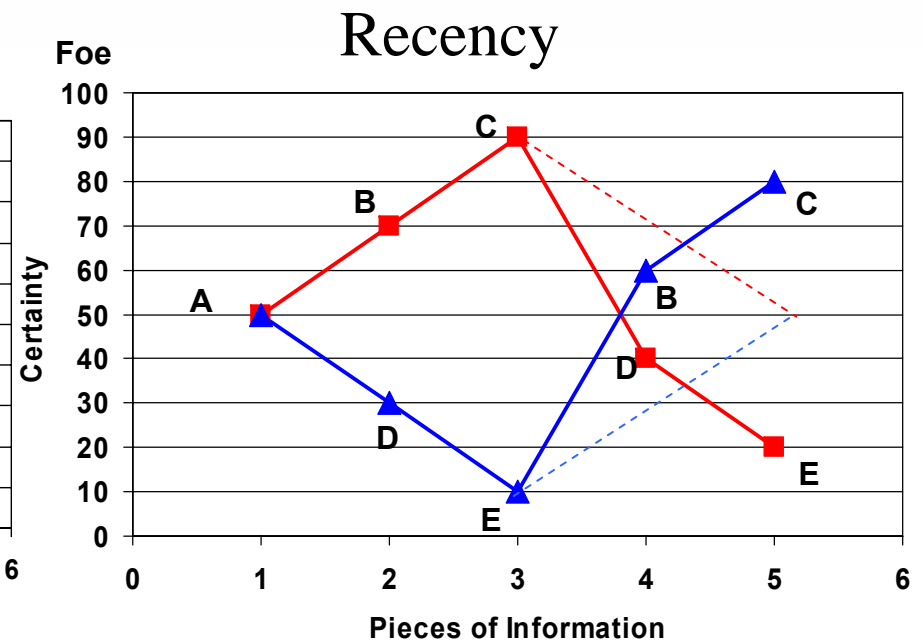**Email: ladelman@gmu.edu**

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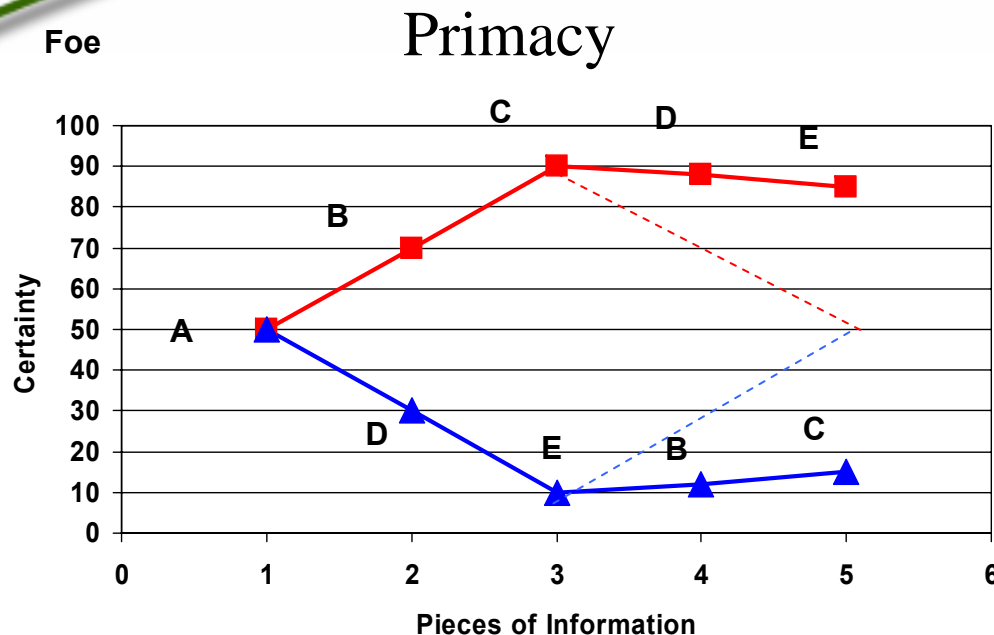
As operators become dependent on systems for decision support, their decisions may be susceptible to order effects which may result in <u>over-weighting</u> of prior or recent information.

Does the theory of anchoring & adjusting on average accurately predict the results of a long series of sequentially presented information when complexity and sequencing are manipulated?

Evidence Items:	Simple		Complex		
Response Items:	EoS	SbS	EoS	SbS	Total
Short Series					
Primacy	21/68%	2	4	1	28
Recency	6	23/88%	14/67%	13/72%	56/61%
No Effect	4	1	3	4	12
Long Series					
Primacy	**15/79%**	**3/60%**	**3/60%**	**-----**	**21/68%**
Recency	**4**	**2**	1	**2/100%**	9
No Effect	**-----**	**-----**	1	**------**	1

$$S_k = S_{k-1} + w_k[s(x_k) - R]$$

- S_k = <u>degree of belief</u> in some hypothesis
- S_{k-1} = <u>anchor</u> or prior opinion
- w_k = <u>adjustment weight</u> for the kth piece of evidence
- $s(x_k)$ = <u>subjective evaluation</u> of the kth piece of evidence
- R = <u>reference point or background</u> to which the impact of the kth piece of evidence is evaluated. R = 0 in evaluative tasks and S_{k-1} in estimative tasks.

$$S_k = S_{k-1} + \alpha S_{k-1}[s(x_k) - R] \text{ for } s(x_k) \leq R \text{ (negative evidence)}$$

$$S_k = S_{k-1} + \beta(1-S_{k-1})[s(x_k) - R] \text{ for } s(x_k) > R \text{ (positive evidence)}$$

- α = sensitivity toward negative evidence; β = sensitivity toward positive evidence.
- As information accumulates and individuals become more committed to their beliefs, values of α and β decrease (become less sensitive).
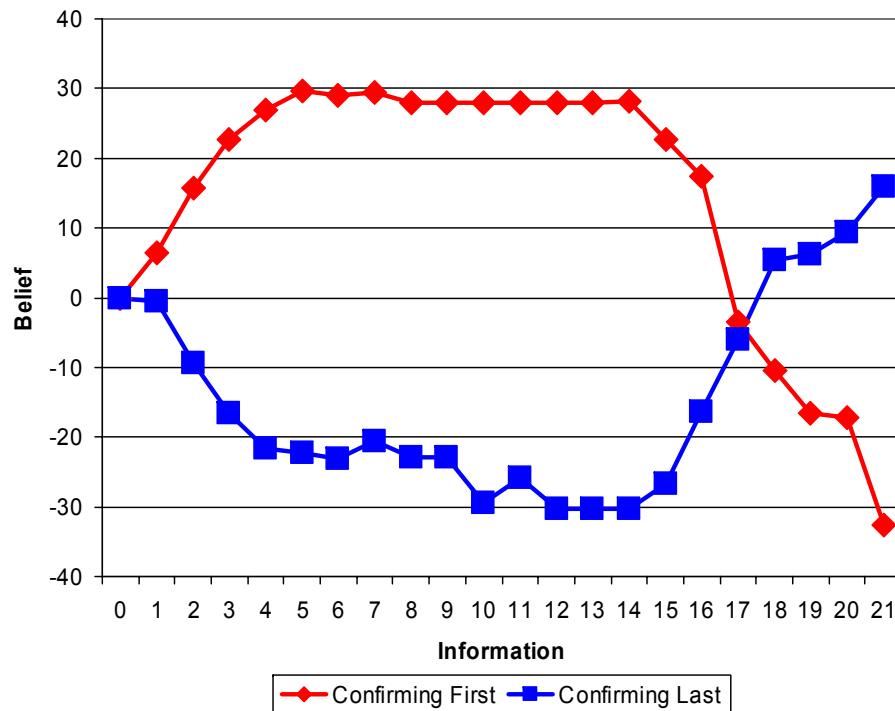
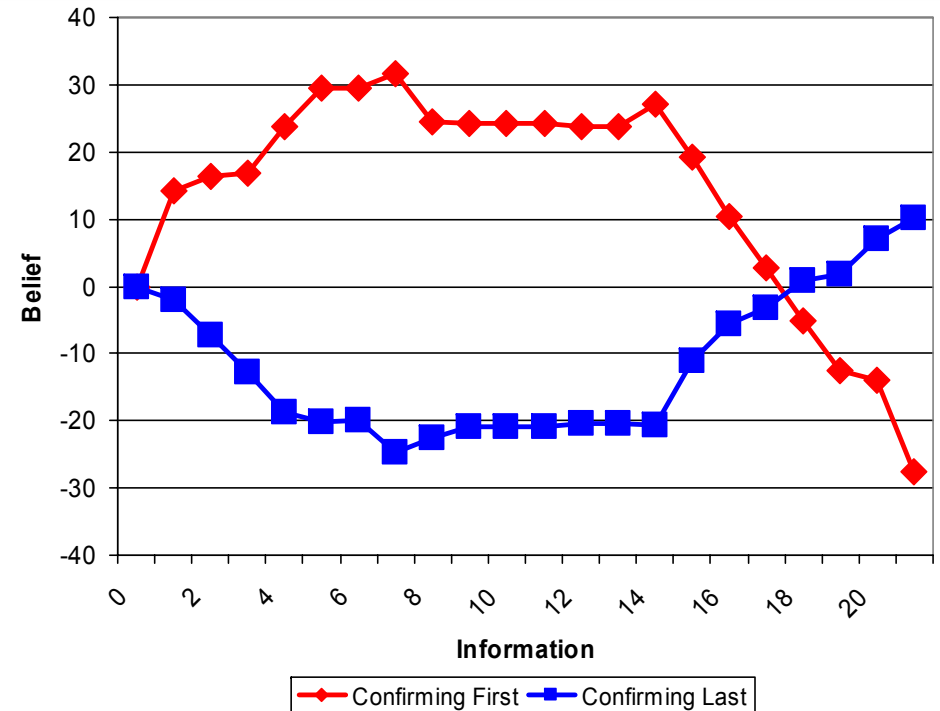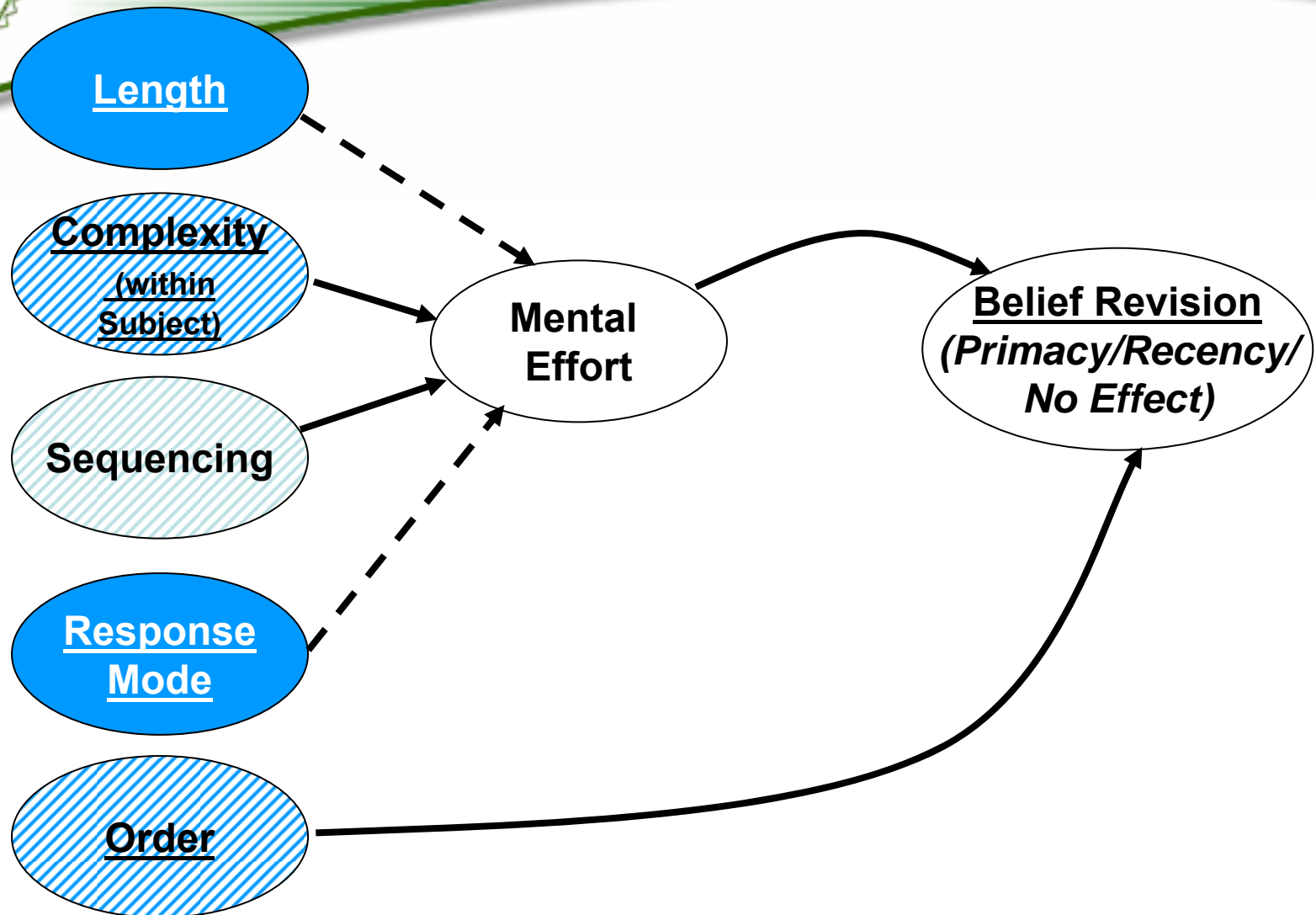| Encoding Evidence:	$R=S_{k-1}$		$R=0$			
	All		Mixed		Consistent	
Response Mode:	EoS	SbS	EoS	SbS	EoS	SbS
Short Series						
Simple	Primacy	Recency	Primacy	Recency	Primacy	No effect
Complex	Recency	Recency	Recency	Recency	No effect	No effect
Long Series	Force towards primacy	Force towards primacy	Force towards primacy	Force towards primacy	Primacy	Primacy

1. Anchoring & Adjusting <u>will not always</u> result in primacy in a long series of sequentially presented information when complexity & sequencing are manipulated.

2. Complexity and sequencing will significantly affect belief revision through a mediator, mental effort.
   - High Mental Effort – Primacy
   - Low Mental Effort – Recency

Manipulation	Variable	Levels
Within-Subjects	Complexity	Simple, Complex
Between-Subjects	Sequencing	Grouped, Mixed
Between-Subjects	Order	<u>Grouped Sequencing</u> CCCCCCCC-NNNNNNNN-DDDDDDDD, DDDDDDDD-NNNNNNNN-CCCCCCCC <u>Mixed Sequencing</u> CC-DNCNDCNDNCDCNDNCNDNC-DD, DD-CNDNCNDNCDCNDNCDNCND-CC

- The experiment was conducted in an ROTC classroom during their regular scheduled Military Science Instruction.
- ROTC cadets were used based on their familiarity with the military.
- Each cadet was asked to sign a consent form approved by GMU's Human Subjects Review Board and then they were then given a booklet containing both tasks.
- Beliefs were rated on a scale of 0-100.
- Mental effort was measured through two questions where responses were obtained using a 1-9 Likert-type scale after each scenario. This measure was based on a method used when measuring cognitive load.
- Pilot Test was conducted with ROTC Instructors & GMU undergraduate students to validate procedures, evidence coding, and to serve as a manipulation check.
- Performed an ANOVA for a mixed factor design to test my first hypothesis.
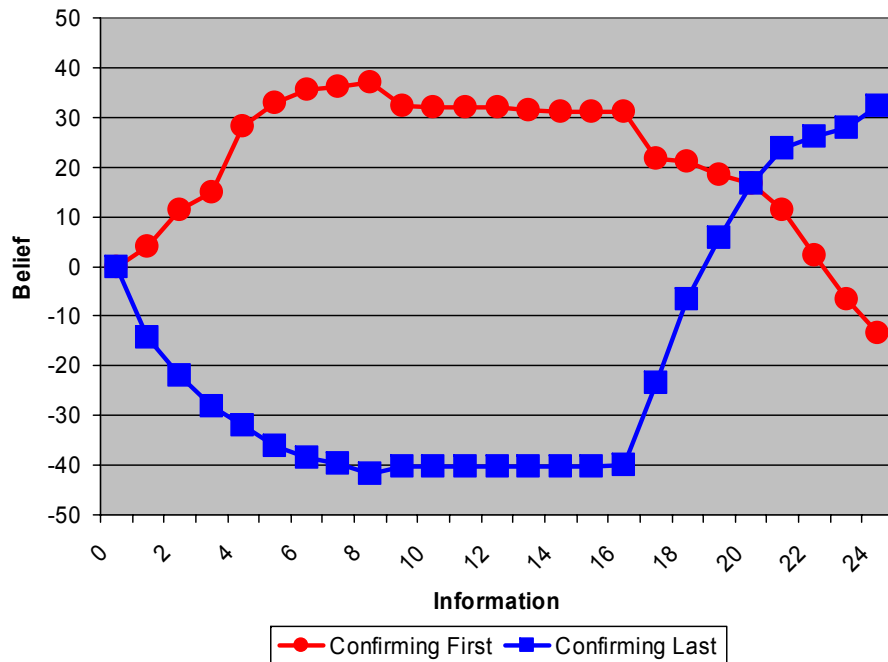- Performed a path analysis to test the second hypothesis.

1. Complexity manipulation check
   - Used 6 ROTC Instructors
   - Included MS Is (freshmen) in Experiment
   - Lengthened Scenarios
   - Bolded and underlined key information
2. Mental Effort manipulation check
   - 14 SEOR Undergrad Students
   - Significant difference (p-value< 0.0001)
   - Movement of neutral information
3. Verbal feedback in the mixed manipulation to ensure correct coding of neutral information
   - Additional 4 GMU Undergrad Students
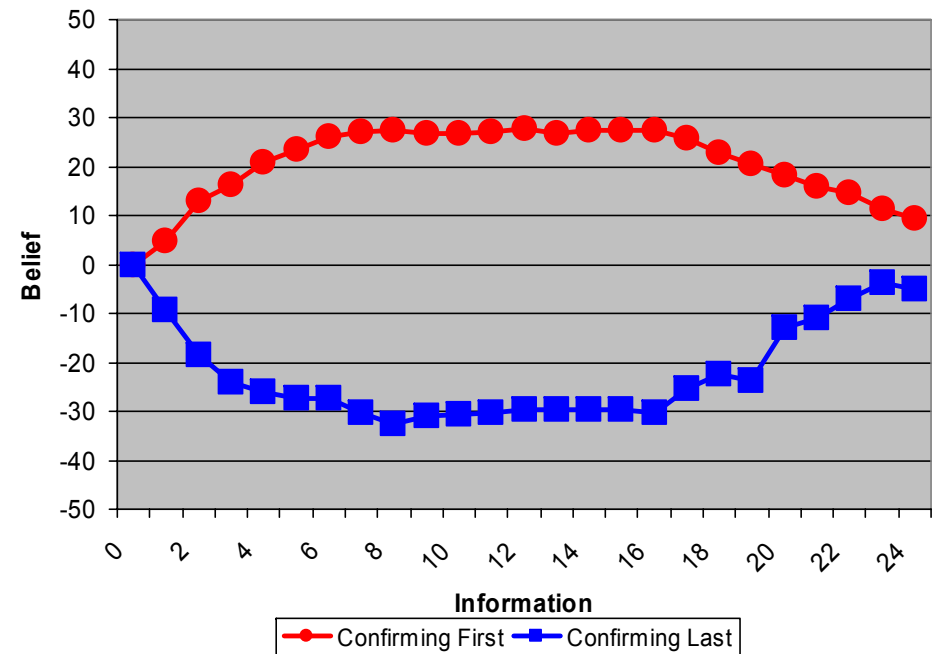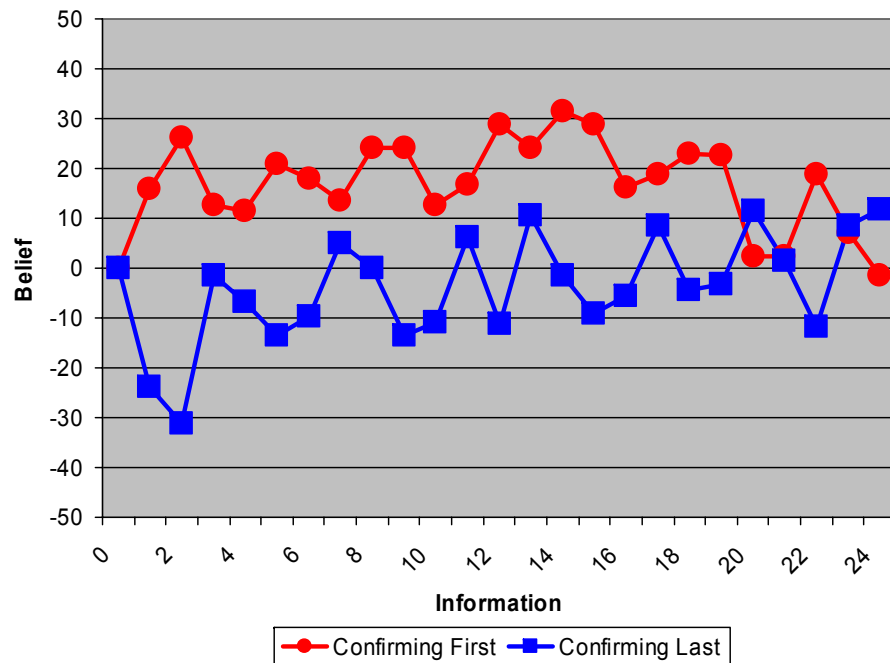   - Special evidence integration instructions

Simple Grouped

Confirming First — Confirming Last

Complex Grouped

Confirming First — Confirming Last

Simple Mixed

Complex Mixed

Complexity
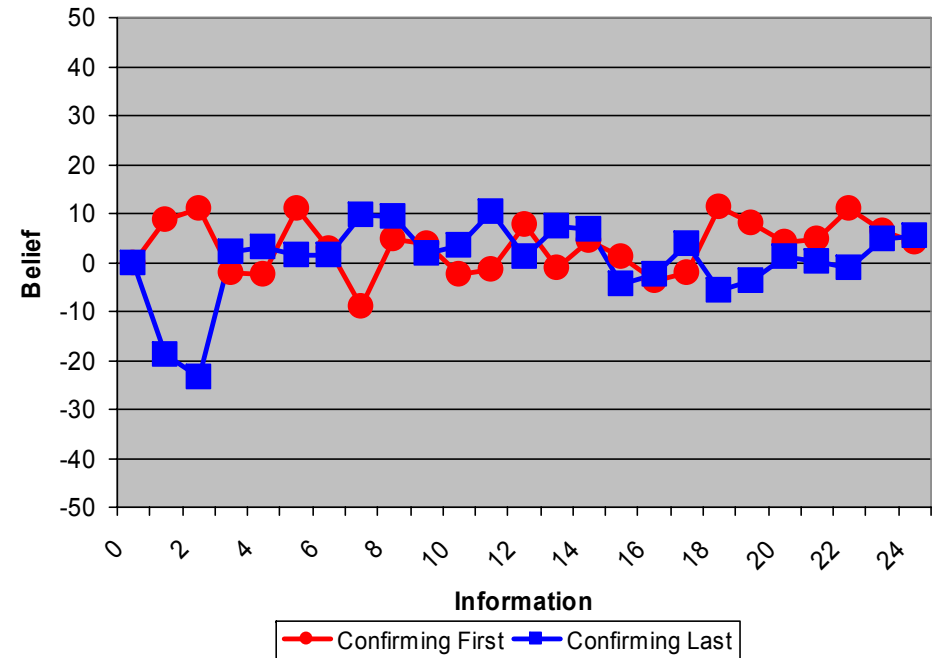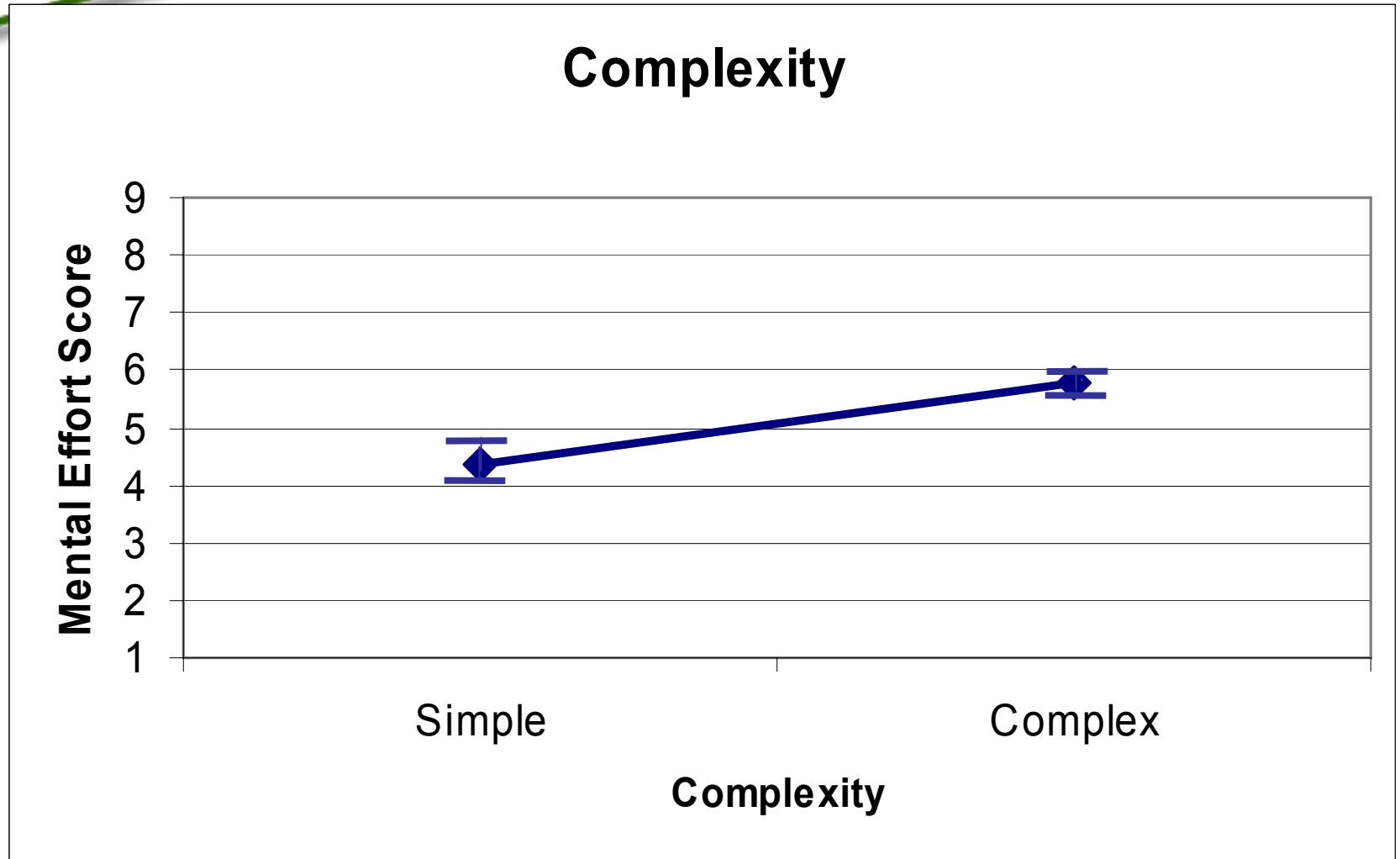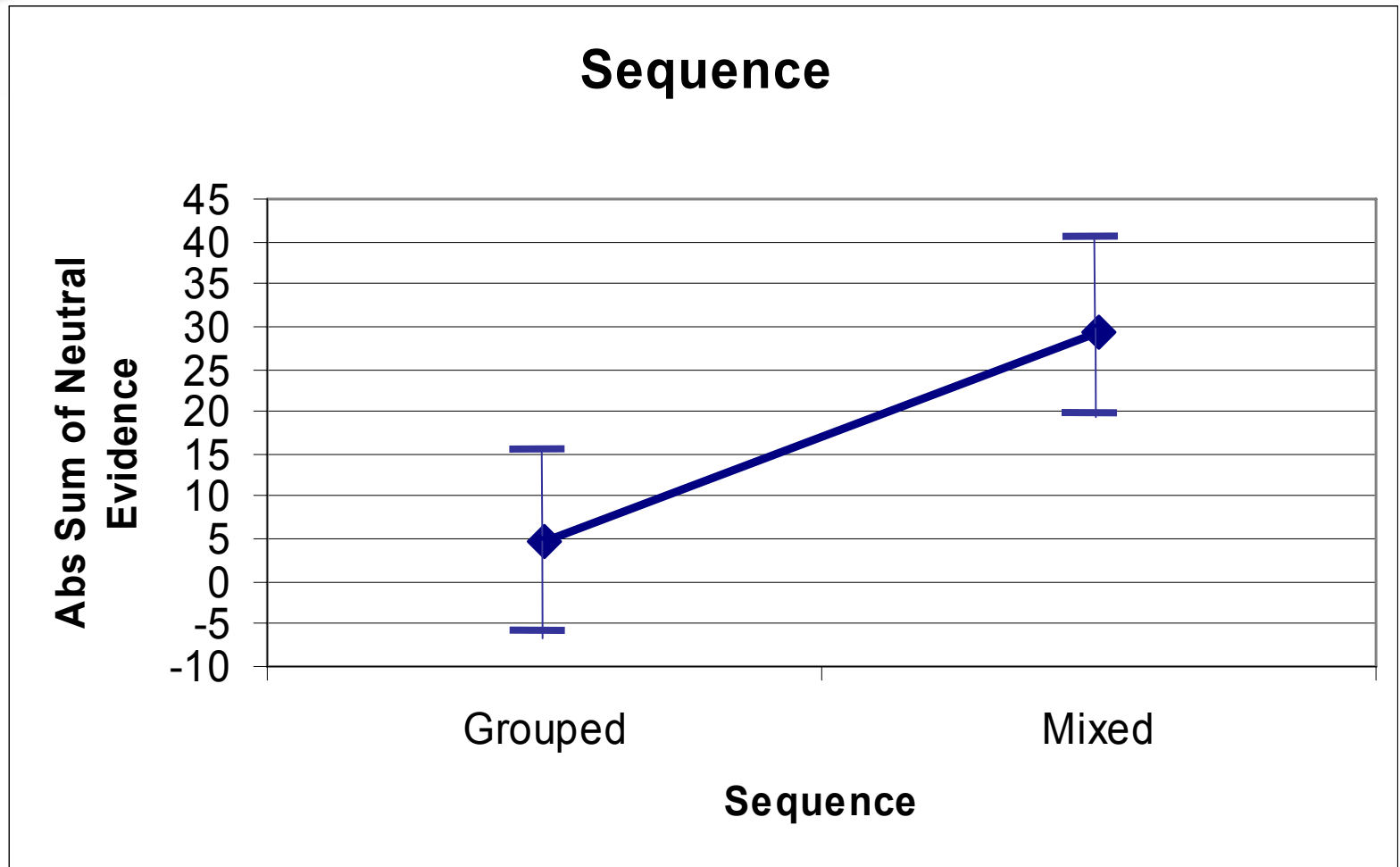
Path Analysis of Mixed Factor Design
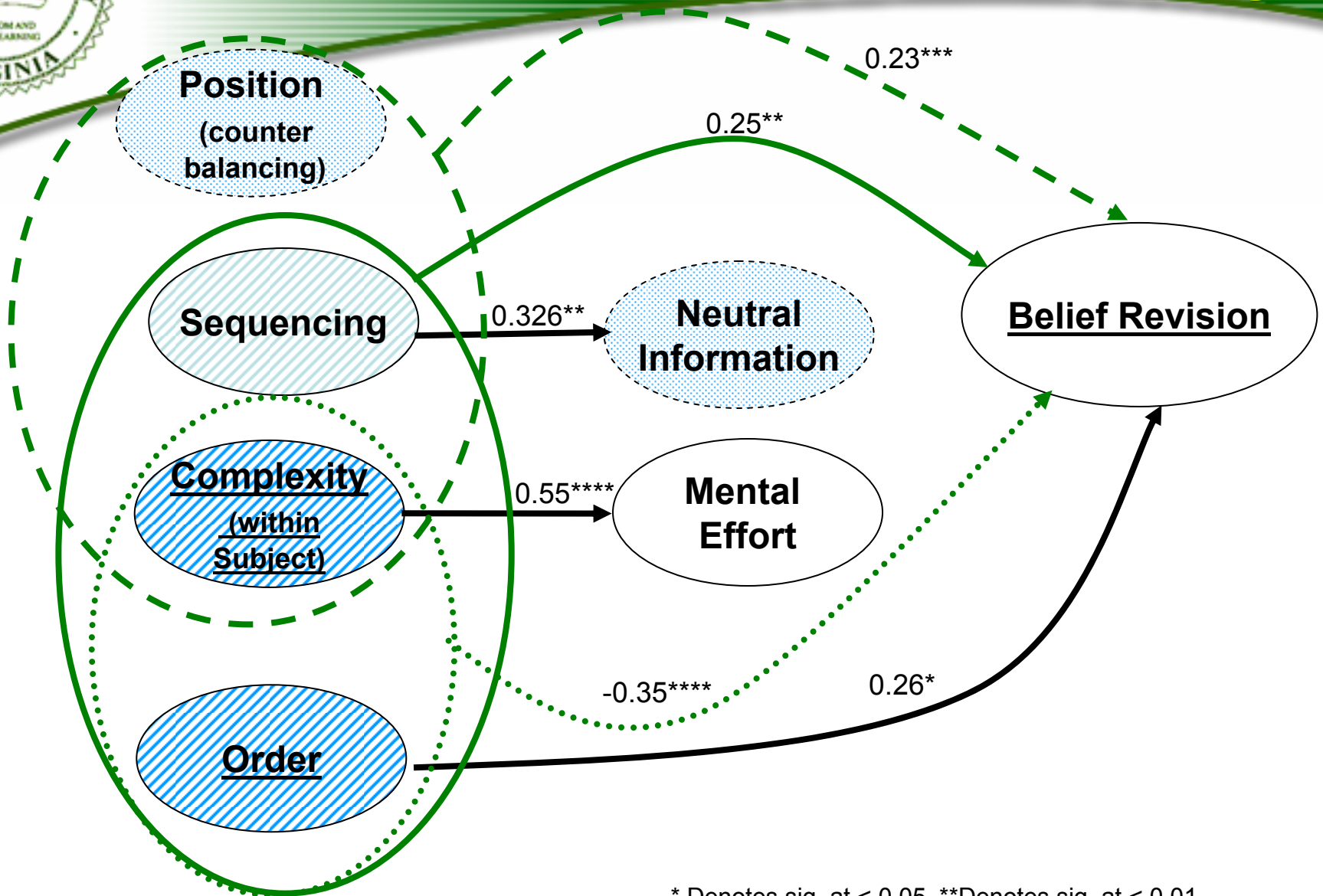
* Denotes sig. at < 0.05, **Denotes sig. at < 0.01,
***Denotes sig. at <0.005, ****Denotes sig. at <0.001.

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Anchoring and adjusting does not always result in primacy in a long series of evidence when <u>task variables</u> are manipulated.

Complexity and sequencing was not mediated through mental effort.

- Effect of task variables
  - Complexity
    - Familiarity
    - Amount of information
  - Sequencing
  - Scenario position
- Potential role of individual differences
  - MS Level
  - Experience
  - Working Memory
  - Intelligence

- Globally Measuring the Mediator
- Individual Measurement of Item Sensitivity
  - Extending model with α_k and β_k
  - Direct measurement (fMRI)
  - Secondary Workload Task
- Mediating Framework
  - Operationalized α and β (sensitivity) based on Hogarth & Einhorn's (1992) theory
  - Anchoring & Adjusting accounts for the grouped manipulation
  - Effect of Neutral Information on mixed sequencing of evidence
- Engineering systems (such as Command & Control) so operators weight information appropriately.

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- GMU's Systems Engineering Undergraduate students for supporting the pilot testing
- Views, opinions, and findings presented are those of the author and should not be construed as an official DoD position, policy, or decision

Back Up Slides

Adelman, L., Bresnick, T., Black, P. K., Marvin, F. F., & Sak, S. G. (1996). Research with patriot air defense officers: Examining information order effects, *Human Factors,* 38, 250-261.

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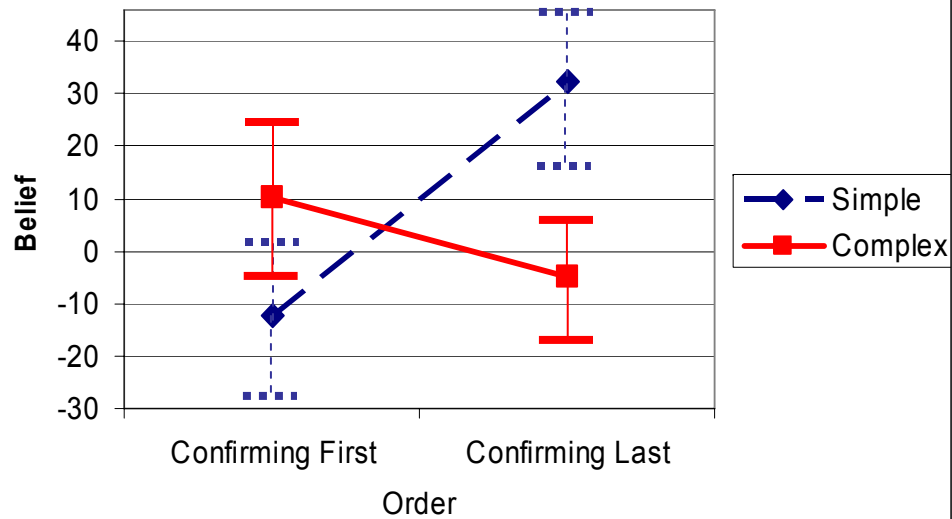| Sequencing		Complexity			
		Simple		**Complex**	
		Order 1	**Order 2**	**Order 1**	**Order 2**
	Grouped	9[1]	12	9[1]	12
	Mixed	13	11[2]	13	11[2]

Complexity (Simple or Complex) is within subject and Sequencing (Grouped or Mixed) and Order is between subject

Note: 1. Three participants' initial judgment was greater than 90.
2. One participant's initial judgment was greater than 90